Recent Investigations among the Pawnee: GEO. A. DORSEY.

In speaking of his recent investigations among the Pawnee, Dr. Dorsey confined his remarks to the description of the offering to the various gods of the heart and tongue of the buffalo, this being one of the rites of an extensive ceremony in connection with a secret bundle among the Skidi band of the Pawnee, which is dedicated to the evening star, the mother of the Pawnee tribe.

One of the interesting features brought out in this presentation was that the fireplace made in the tipi during the ceremony is rectangular in shape, and not round, this being supposed to be the shape of that garden in the west presided over by the evening star, and in which the heat of the sun is periodically renewed.

ROLAND B. DIXON,
Secretary.

HARVARD UNIVERSITY,

THE WASHINGTON MEETING OF THE GEOLOGICAL SOCIETY OF AMERICA, DECEMBER 30, 31, 1902, JANUARY 1 AND 2, 1903.

THE society was called to order Tuesday, December 30, in a room in the building of the U. S. Geological Survey. The attendance was very large, from 75 to 100 fellows being present. An address of welcome was delivered by Director C. D. Walcott and was acknowledged by President N. H. Winchell. After routine business, memorials of Alpheus Hyatt (by W. O. Crosby), J. E. Mills (by J. C. Branner) and J. W. Powell (by W J McGee) were read. The presentation of papers was then begun, and the following were read during the meeting. Inasmuch as the society held joint sessions with Section E of the American Association for the Advancement of Science, it is impossible to give the papers in the exact order of presentation. Section E had a full program, as did also the Geological Society, and related titles were presented in succession, without regard to the body to which they had been primarily offered. In this report the printed program of the Geological Society is followed. The companion report by Dr. E. O. Hovey covered the papers primarily offered to Section E. Where an author was absent his paper is only mentioned at the close of this report, among those read by title.

The First Eparchœan Formation: H. M. AMI, Ottawa, Can.

This paper was an extension of one presented at the last winter meeting and entitled 'The Ordovician Succession in Eastern Ontario.' It emphasized the nature of the first formation which overlies the Archean crystallines in different portions of North America. Dr. Ami showed that the first Paleozoic sediments in the southern Appalachians are fragmental and of lower Cambrian age, while as we come north the strata resting on the ancient crystallines are successively later and later in age, until in Canada we find them at the top of the Ordovician. He, therefore, emphasized the probability that the earliest fossils were only to be expected in the south.

In discussion C. R. Van Hise urged the importance of care and exactness in the use of the term 'Eparchean Interval.' If used in the sense first proposed by Lawson on Lake Superior it would be a pre-Cambrian term, whereas in the paper of Dr. Ami it might as a time expression come anywhere up to the top of the Ordovician. Transgression and overlap need also to be considered. Bailey Willis remarked the distinct faunas which occurred in the same kind of rock, and emphasized the principle that lithology could not stand for time, nor has it faunal significance.

A. W. Grabau mentioned that the progressive overlap could be carried farther even up into the Silurian; and also that in New York we have in the Niagara limestone a formation whose time equivalent ought to be a sandstone in Ontario. N. H. Winchell carried the idea still farther in that in Minnesota the Cretaceous rests on the Archean, and stated that the break might be traced even to the present. Dr. Ami, in reply, stated that he used the term 'Eparchean Formation' in a purely stratigraphic sense with the purpose of emphasizing the first sandstone deposits found in various places in the East.

The Basal Conglomerate in Lehigh and Northampton Counties, Penn.: FREDERICK B. PECK, Easton, Pa.

The basal conglomerate occurs here as elsewhere, fringing the Precambrian areas. In eastern Northampton County it fails occasionally, (1) as a result of faulting or (2) because it was never deposited. It has a thickness varying from zero at Easton, to one hundred or possibly several hundred feet at Alburtis, twenty-four miles southwest of Easton.

Petrographically, it is quite variable. At times it is a coarse conglomerate, made up of quartz pebbles an inch or two in diameter. Frequently it is a medium to fine-grained arkose, consisting of about one part feldspar (orthoclase and microcline) to two or three parts quartz, the former usually thoroughly kaolinized, the latter badly crushed, and under the microscope exhibiting an undulatory extinction, and occasionally a distinctly biaxial character. Other phases of it present a dense bluish or grayish quartzite. It occasionally contains interstratified beds of a very fine-grained, argillaceous sandstone with numerous worm borings (*Scolithus*), but as yet no distinctively lower Cambrian fossils have been found. The seemingly uppermost member is a highly ferruginous, almost jaspery quartzite, which locally contains iron enough to constitute a low grade ore. From this horizon a considerable amount of iron ore was formerly derived.

In discussion Bailey Willis remarked the difficulty of tracing the break between the ancient crystallines and the lowest sediments when the latter consist of the weathered débris of the former, deposited near their source. If, however, the lowest beds are sandstones, such as now form the beaches along the Atlantic, they represent the residues, which have been repeatedly worked over by the sea, and have no necessary relations to the neighboring crystallines.

Dr. Peck replied that, in his area, they seemed to represent the products of secular decay, and to have been deposited near their source.

The Sandstones of the Ozark Region in Missouri: CURTIS F. MARBUT, Columbia, Mo.

The author first gave a short sketch of the history of geological investigation in the region, with reference chiefly to the various classifications which have been proposed for the rocks of the Ozark series. The older geologists made out four limestones and three sandstones. F. L. Nason had supported the view that there were two limestones and one sandstone. By means of maps the speaker described the evidence which had led him to the conclusion that there are certainly two, and there may be three or even four, sandstones.

Dr. Purdue remarked in discussion that there are in Arkansas at this horizon heavy sandstones and limestones, seven in number, which shade into each other.

Devonian and Carboniferous Rocks of Southwestern New York: L. C. Glenn.

The speaker discussed, with the aid of diagrams and maps, the puzzling question of the transition strata on the border between the Devonian and Carboniferous of southwestern New York and northern Pennsylvania. The strata are prevailingly shales with lenticles of conglomerate. They have received formational names, and by agreement between the paleontologists of New York and the U. S. Geological Survey the break between the periods has been placed at the base of the Wolf Creek conglomerate. In discussion J. M. Clarke described the nature of the faunal change. It is more sharply marked at the Wolf Creek conglomerate than elsewhere, although these are both antecedent Carboniferous forms and surviving Devonian ones, respectively, below and above the conglomerate.

H. S. Williams, likewise, emphasized the faunal relations, and also discussed some of the equivalencies of conglomerates in separated areas, suggested by the author. Another speaker remarked the possibility of throwing much light on the boundary between Devonian and Carboniferous by an investigation in southeastern Pennsylvania of the strata under the anthracite measures.

This paper closed the morning session. On reassembling after lunch the society divided into a petrographic section and a stratigraphic, each being held in different rooms. The stratigraphic papers follow immediately; after them the petrographic are given.

Stratigraphic Relations of the Red Beds to the Carboniferous and Permian in Northern Texas: Geo. I. Adams, Washington, D. C.

As a result of a reconnoisance in northern Texas it has been learned that the Wichita and Clear Fork divisions of the Permian, as defined by Mr. Cummins, of the Texas Survey, are in part equivalent to the Albany and Cisco divisions of what has been considered Carboniferous. The approximate limit of the red color is a line diagonal to the strike of the formations.

Comparison of Stratigraphy of the Big Horn Mountains, Black Hills and Rocky Mountain Front Range: N. H. Darton, Washington, D. C.

This communication embodied some of the results of several years' detailed study of the stratigraphy of Black Hills and Big Horn Mountain uplifts, and a series of observations extended along the front ranges of the Rocky Mountains in Wyoming and Colorado to ascertain the stratigraphic relations of the Cambrian to the Cretaceous formations in their southern extension. It has been found that the broader features are of wide distribution, but they present local variations due to differences in overlaps and dates of uplift. Some distinctive beds at several horizons have been traced continuously from far north in Dakota through Wyoming and Colorado, affording important reference planes for the correlation of the more variable or less distinctive members. The data throw much light on the history of the uplifts, especially the discovery of Laramie conglomerates containing carboniferous limestone pebbles.

The paper was illustrated by colored slides. One of the points emphasized by them was the unconformable contact between the Marine Jura and the Red beds or Permic. This unrepresented interval corresponds to the Trias.

Age of the Atlantosaurus Beds: W. T. Lee. Trinidad, Col. (Introduced by W. B. Clark.)

The paper dealt with the extension of the *Atlantosaurus* shales from their type local-

ties along the Rocky Mountain front southward into New Mexico and eastward into Oklahoma. The shales contain fossils, by which they can be correlated with the Lower Cretaceous of Texas.

A characteristic Lower Cretaceous fossil from these beds was exhibited. Professors Scott and Williston, in discussion, considered that the Lower Cretaceous age of the beds was proved by the vertebrate fossils. Both preferred the term 'Como beds' to Atlantosaurus beds. Mr. Darton had discovered similar Lower Cretaceous invertebrates in these beds.

Mr. Stanton argued that the occurrence of lithologically similar beds on the Red beds was not conclusive evidence of their stratic equivalency.

The Cretaceous-Eocene Boundary in the Atlantic Coastal Plain: W. B. CLARK, Baltimore, Md.

Some of the difficulties encountered in cartographically representing the boundary line between the Cretaceous and Eocene deposits along the Atlantic coastal border were presented. These difficulties consist, in New Jersey, in locating, on account of the continuity of deposition, a clearly defined line separating the Eocene from the Cretaceous; and in Delaware and Maryland, in determining the boundary line, because of the apparent mechanical transportation of Cretaceous fossils into the Eocene deposits where they exist side by side with Eocene forms.

The formations discussed are: (1) Potomac, possibly Upper Jurassic to Lower Cretacic, (2) Upper Cretacic, (3) Eocene, (4) Miocene and Pleocene. Marked differential movements occurred at different periods accompanied by pronounced transgressions and retrogressions. In discussion Bailey Willis made a comparison between the Atlantic and Pacific coast belts.

The Marl-loess of the Lower Wabash Valley: M. L. FULLER, Washington, D. C., and F. G. CLAPP, Boston, Mass.

A study of the marl of the lower portion of the valley of the Wabash River in southern Indiana and Illinois shows it to be the equivalent of the loess, replacing the latter over considerable areas. This marl-loess is usually a little coarser than the common loess and carries about 30 per cent. of $CaCO_3$, as compared with less than 5 per cent. in the common type. Numerous exposures have been discovered in which the materials are distinctly or even conspicuously stratified, and in some instances thin interbedded layers of fine gravel were noted. It is frequently abundantly fossiliferous, the forms being stated as a mixture of aquatic and land species. The stratified marl-loess appears to reach an altitude of about 500 feet, or some 120 feet above the flood plain of the river. Instead of forming a mantle conforming to the surface inequalities, as is the case with the common loess, the marl-loess frequently occurs as extensive flats on broad gently sloping terraces at elevations ranging from 40 to 120 feet above the river. Beneath these there is usually buried a somewhat rugged topography. In distribution, the marl-loess is confined mainly to the east side of the valley, an occurrence which is most favorable to the hypothesis of wind origin, but the balance of evidence appears to be in favor of the view, with certain limitations, of aqueous origin.

The paper was illustrated by lantern slides. Professor Chamberlin stated that the stratified deposits in question had perhaps been wrongly called loess by himself and others, as they were not like the true loess. He suggested that the term, loess-like alluvium, was more expressive of its character. The paper was also discussed by Professor Salisbury and others.

Ames Knob, North Haven, Maine; A Seaside Note: BAILEY WILLIS, Washington, D. C.

Ames Knob is a mass of andesitic volcanic rock rising 160 feet above the sea, on the neck of land between the Fox Island thoroughfare and South Harbor, North Haven Island, in Penobscot Bay. Its petrographic character and geologic relations have been described by G. O. Smith, in his essay on the geology of the Fox Island, Maine. It is bounded on the north by a low plain cut on shales and limestones, of Niagara age, and its northern slope is a cliff resulting from the relatively great hardness of the igneous rock. The other slopes of the knob are of practically uniform rock, and variations in profile are attributable to conditions of attack, rather than of resistance. At an altitude of approximately eighty feet above the sea, on the southeastern and southern sides facing the Atlantic Ocean, is a well-marked bench from which a steep facet rises to the summit of the knob. This bench, which has an average width of about 200 yards, is attributed to the action of waves cutting at sea level. The rocks in place exposed upon this bench and about its margin exhibit rounded glaciated profiles, but no longer bear striæ, so far as observed. Hence it is inferred that the date of submergence to this level preceded or was nearly coincident with the latest episode of glaciation, and that later influences have removed the minor evidences of ice action. Upon this glaciated bench there are now deposits of glacial gravel having the characteristic forms of spits and bars, which are accordingly attributed to wave and shore currents. These deposits indicate the presence of the sea at this level after the retreat of the ice.

The simplest explanation of the facts is that Ames Knob was submerged beneath the sea to a depth of eighty feet above the present sea level during and immediately after the latest glacial episode.

Geology of Becraft Mountain, N. Y.: AMADEUS W. GRABAU, New York City.

Becraft Mountain in Columbia Co., N. Y., is an outlier of the Helderberg Mountains. Its base is formed by the upturned and eroded rocks of the 'Hudson' group—chiefly the Norman's Kill shales. Unconformably upon this rests the Manlius limestone (upper part), followed in turn by the members of the New York Devonian up to and including the Onondaga limestone. A detailed geological map has been prepared by the author for the New York State Survey, Department of Paleontology, and was exhibited by permission of the State Paleontologist. The structure of the eastern and southern portion of the mountain, which is of the Appalachian type, was discussed. The excessive folding and faulting of this portion of the mountain was illustrated by a map and sections.

In the petrographic section, Professor B. K. Emerson presiding, the time was largely devoted to a description and discussion of the new system of classification of the igneous rocks which has been prepared and published in a recent number of the *Journal of Geology* by Messrs. Cross, Iddings, Pirsson and Washington. By means of charts J. P. Iddings first described briefly the general principles on which the system is based and the equivalent terms under the old system. H. S. Washington then discussed the chemical aspects and the methods and reasoning by which the authors were led to their results. He showed the chemical and mineralogical confusion which exists in the old scheme and the improvements afforded by the new. Before discussion was called for, J. P. Iddings presented the following:

Chemical Composition of Igneous Rocks expressed by Means of Diagrams: JOSEPH P. IDDINGS, Chicago, Ill.

The diagrams express the molecular proportions of the chief chemical components of igneous rocks; the range of their variation; the gradations of igneous rocks chemically between extremes; the grouping of them according to the system of quantitative chemico-mineralogical classification, recently proposed by Cross, Iddings, Pirsson and Washington. The new diagram differed from the old in that, in place of the dots which were distributed in the earlier charts of the author (see *Journal of Geology,* April–May, 1898, 219), little colored geometric figures were used, drawn by the method of Brogger. Exceedingly expressive pictorial representatives of the chemistry of the eruptive rocks were thus afforded.

When discussion was called for, it was first directed against the new names suggested by the syndicate scheme of classification, and some exception was taken by G. P. Merrill to the felicity and significance of the ones selected. This was very well met by the authors, who described the process of evolution through which they had reached the ones of their choice. W. H. Hobbs critically discussed the relative numbers of analyses on which the ranges were established, urging their fewness in some cases and their abundance in others. He made the point that some indicated little more than specimen analyses. In reply, the authors showed the variety of the rocks where the analyses were few, and their abundance in the cases of the more common rocks. They also described the care with which analyses had been selected. J. F. Kemp spoke of the good results in diffusing a knowledge of the molecular proportions instead of the percentage composition which would be accomplished by the scheme. He instanced the difficulty of recasting analyses involving the alferric minerals as the stumbling-block in close work, and preferred percentage statistics of the minerals in the thin sections to the calculated 'norms.' He also felt reluctant to see texture, which is now so important, become so minor a feature. A. C. Gill spoke somewhat critically of the essential significance of 'norms' which are artificial assumptions, corresponding to no mineral in the rock. He spoke of the good results which could be gained by the use of the percentage of silica as a fundamental principle in arranging cards of analyses, subdividing them, after the choice of convenient groups, on the basis of other components.

On the whole from the discussion the more vulnerable part of the proposed scheme appeared to be the difficulty of calculating percentages from many analyses and the matter of the norms. With the many advantages of another sort and with its definiteness and logical order, all present were impressed.

The Nephelite Syenite Area of San José, Tamaulipas, Mexico: GEORGE I. FINLAY and J. F. KEMP, New York City.

The San Carlos Mountains, in the state of Tamaulipas, Mexico, are largely made up of nephelite-syenite. This rock is exposed for ten miles along the range south of the town of San José. With it are associated dacite and andesite in the form of a laccolith, and dikes of tinguaite, analcite-tinguaite, camptonite and diabase. The general geology of the San José district was given, with a discussion of the field relations of the above rock types. They were described petrographically, and their mineralogical and chemical relations are treated in accordance with the syndicate scheme of classification outlined above.

The hour being late there was no discussion and the separate section adjourned.

On reassembling Wednesday morning the following two papers were delivered together.

Studies in the Grain of Igneous Intrusives: ALFRED C. LANE, Lansing, Mich.

In studying the genesis of minerals from an igneous magma, the importance and interest of studying specimens at various known distances from the margin will be illustrated by particular instances. Slides of chips taken at known distances from the edge of flows were passed around, and even to the unaided eye the increase of coarseness toward the center was marked. The subject was then treated mathematically in connection with diagrams and with the next title:

On the Porphyritic Appearance: ALFRED C. LANE, Lansing, Mich.

There are some five different kinds of phenocrysts, or crystals, which may give a porphyritic appearance, to wit:

Coarser relics of a previous consolidation.

Crystals whose formation took place during the migration of the igneous magma.

Crystals which were formed early in the process of cooling and solidification, so that their grain continues to increase clear to the center, while later formed constituents increase only for a shorter distance from it, their grain thereafter remaining uniform. This porphyritic type will be most obvious at the center of the igneous mass.

Crystals, the conditions (temperature) of whose formation were nearly half way between those obtaining initially in the igneous magma and the country rock. Such crystals will be most conspicuously porphyritic at or near the margin.

Finally there may be crystals which, like the staurolite of schists, are formed by metamorphic actions, of secondary origin, and occur in sediments, and only casually occur in igneous rocks.

Attention is particularly called to the third and fourth classes, the possibility of the existence of which has been almost overlooked, though their possible existence may be readily inferred from inspection of diagrams of the cooling of an intrusive. Certain field observations render their actual existence probable.

A Plumose Diabase containing Sideromelan and Spherulites of Calcite and Blue Quartz: B. K. EMERSON, Amherst, Mass.

The paper gave a description of an extensive series of specimens of coarsely porphyritic diabase possessing feathery pyroxenes several inches long, and much very easily soluble tachylite or sideromelan, together with spherulites of calcite and this glass, or of deep cobalt-blue glass, radiating from a point near the border. The whole is thought to have been caused by the indraught of much calcareous mud, its solution in the magma and recrystallization. Many specimens were passed from hand to hand in illustration.

Shifting of Faunas as a Problem of Stratigraphic Geology: HENRY S. WILLIAMS, New Haven, Conn.

A comparison of sections through the upper and middle Devonian rocks of the New York-Pennsylvania province discloses marked differences in the faunas occurring at corresponding levels. These facts were presented and their explanation found in a shifting of faunas during the time represented. The nature, extent and mode of recognition of faunal shifting in studying stratigraphy were discussed, and some conclusions, suggested by the facts, were drawn as to the desirable modification of customary practices in correlating formations by their fossils.

The sections, eight in number, extended

from Licking Co., Ohio, to Pike Co., Pa., a distance of over 500 miles. They are arranged in groups with intervals of about 100 miles. There is an almost continuous thickening to the eastward, which to the southeastward increases strongly. Three types of sediment were noted: (1) The red shale and sandstone type, especially found in the eastern end of the section. They are estuary deposits with a peculiar fish fauna. (2) The argillaceous shale type with a rich marine fauna. (3) The Black shale type with a depauperated fauna, chiefly western. The faunas shifted with the sediments.

The paper was discussed by Professor Stevenson and others.

Paleozoic Coral Reefs, with Notes on the Classification of Limestones: AMADEUS W. GRABAU, New York City.

Dome-like coral reefs have been studied by the speaker in the Paleozoic rocks of western New York, the southern peninsula of Michigan and in southeastern Wisconsin. Similar reefs have beeen described by Wyman from the Silurian of Gotland, and by Dupont from the Carboniferous of Belgium. Three types of fragmental limestones were discussed and the following terms were defined: *calcirudite, calcarenite* and *calcilutite,* corresponding to *psephite, psammite* and *pelite* among the siliceous sedimentary rocks. The desirability of such distinctive names was set forth and examples were given.

The paper was illustrated by diagrams. It was discussed by Messrs. Chamberlin, Rice, Lane, Fairchild and others. The desirability of distinctive names for the types of fragmental limestone was conceded.

Primitive Characters of the Triassic Ichthyosaurus: JOHN C. MERRIAM, Berkeley, Calif.

The paper presented a comparative study of the Triassic Ichthyosaurus with a view to determining the stage of evolution reached in these forms as compared with that seen in the Jurassic representatives of the order.

The work is based mainly on an examination of collections obtained from the upper Triassic of northern California by the University of California in the summer of 1902. In the material now available the important characters of the dentition, and of the heretofore imperfectly known paddles, can be determined with certainty.

The paper was illustrated by numerous lantern slides.

Distribution of Mastodon Remains in New York: JOHN M. CLARKE, Albany, N. Y.

Sixty mastodons have been found in New York, mostly along certain well-marked belts, viz., thirty-four in eastern New York from Albany south through Newburgh; thirteen from Rochester south through Livingston County, two near Chautauqua Lake and two near Ithaca. Outside these belts the state is barren. They, therefore, had distinct feeding grounds and that too in a not very remote time. They are now usually found resting on the boulders of old streams and in a comparatively thin layer of peat.

In discussion A. C. Lane said that in Michigan they are found down to twenty-five feet below the level of the Great Lakes. E. C. Buckley stated that in Wisconsin they occurred in the driftless area and in streams. G. F. Wright said that near Oberlin, Ohio, they are found in peat, between the second and third beaches of Lake Erie. The question was raised as to the presence of the mammoth in New York, and it was shown that no specimen had yet been discovered. When, therefore, President Roosevelt, at the time Governor of New York, urged that the mammoth should appear on its coat of arms, it was evident that although

a mighty hunter of existing big game, he was a bit weak as regards extinct types.

Permian Elements in the Dunkard Flora: David White, Washington, D. C.

The Dunkard series (Upper Barren Measures, XVI.) includes the topmost Paleozoic sediments in the Appalachian trough. It lies in southwestern Pennsylvania, eastern Ohio and northern West Virginia, its maximum thickness, in West Virginia, probably exceeding 1,200 feet. Its age determination rests chiefly on the land flora, the series being non-marine. The paleobotanical and lithological conclusions that the series is Permian, reached by Professors Wm. M. Fontaine and I. C. White, have been seriously questioned by some American geologists and paleontologists. Recent collecting materially increases the Permian evidence, and seems to leave little room for doubt that the beds in and above the Washington limestone are referable to the Lower Rothliegende of western Europe. The data so far obtained from the lower beds of the Dunkard are, in the judgment of the writer, not yet conclusive as to Permian age. The problem is difficult on account of the great paucity of characteristic Permian forms and the presence of a transition flora. Beds of Zechstein age seem not to have survived erosion in the Appalachian trough.

Dr. I. C. White discussed the paper and expressed his pleasure that the Whites were of the same shade of opinion for once.

Configuration of the Rock Floor of the Vicinity of New York: William H. Hobbs, Madison, Wis.

New York city and its approaches are now the focus of engineering enterprises never before paralleled in the history of the world. The revelations afforded by these public and private undertakings are of much significance from a geological point of view, particularly, however, as regards the formation of the island and the channels surrounding it. To the data now being furnished have been added many from earlier enterprises—the numerous bridges, tunnels, well borings, foundations, etc. Many lantern slides were shown, based on the profiles of engineers and showing crushed belts and streaks of decomposed rock under the river channels and depressions. The speaker, therefore, developed an argument in favor of faults as the cause of the depressions, and as the guiding cause of the rivers in opposition to the limestone belts which have been hitherto regarded as the main directing cause.

In discussion J. F. Kemp stated the points in favor of the limestone, while admitting for certain localities the force of Dr. Hobbs's reasoning. He urged that soft and decomposed belts sometimes occurred without visible connection with faults. J. W. Spencer spoke somewhat in favor of the limestones and regarding the difficulty of demonstrating faults, as did also Bailey Willis, who, however, cited a fault which he believed to exist, bounding the southeastern edge of the ridge of Staten Island.

On the Drowned Valleys off the North Atlantic Coast: J. W. Spencer, Washington, D. C.

This paper is a sequel to the same study presented to this society, and published in the *Bulletin* in 1894. The subcoastal plains were described. They have a breadth of from 20 to 80 miles, or 300 miles off Newfoundland, reaching to a depth of 200 to 250 feet, with, in places, an outer terrace 200 feet lower. Across this Lindenkohl traced the Hudson valley to a cañon nearly 3,000 feet below sea-level, while the author recognizes its continuation, in the contours of the con-

tinental slope, to oceanic depths. Chesapeake and Delaware valleys are buried on the subcoastal plains, but reappear in cirques at their margin, and can be traced to 60 miles down the continental slope, where they enter a deep embayment, like the Hudson. The valleys of the Gulfs of Maine and St. Lawrence, and smaller ones, are traced across the subcoastal plains into conspicuous amphitheatres in the edge of the continental shelf, and these widen out into embayments indenting the great slope to oceanic depths. The continuation of the deep fjords of Newfoundland are obstructed, supposedly by drift, in crossing the coastal plain, but this is in agreement with the fact that the Lafayette formation is older than the great valley-making epoch, but the Columbia formation was subsequent to it.

So also the remarkable deep cirques in the far North Atlantic were described.

The author considers these features, which have their analogies on the margins of the Mexican tablelands, as having been finally fashioned by atmospheric agents, in which case they become evidence of great continental elevation about the beginning of the Pleistocene period. The paper was admirably illustrated by a series of maps.

Geology of the Leucite Hills, Wyo.: W. C. KNIGHT, Laramie, Wyo., and J. F. KEMP, New York city.

The petrography of the Leucite Hills has already been quite fully treated, but the geological relations have been hardly touched. The latter furnish the most important part of the paper, but petrographic details are not neglected. Up to date six separate exposures have been partially described. The authors have located and mapped twenty-two. The maps thus far prepared are incomplete and inaccurate. The authors have surveyed one which expresses the true relations much more faithfully. Surface flows, dikes, volcanic necks and at least one probable intruded sheet were described. The stratigraphical relationships, the probable time of intrusion and the dissection of the mesas were treated in closing, and it was shown that the outbreaks probably occurred in the late Tertiary. In discussion G. K. Gilbert remarked the probable derivation of the sheets and dikes from a parent magma, and the illustrations which they afforded of the succession of closely related eruptions from one source. Bailey Willis likewise commented on the probability of the existence of a great laccolithic reservoir beneath the surface.

The Work of the Geological Survey of Canada in 1902: ROBERT BELL, Ottawa, Canada.

The paper discussed the following topics: The different classes of workers, their numbers. Field-work; the parties which were sent out, objects to be attained, means employed; regions surveyed and explored from the Yukon District to Nova Scotia; some of the results. Work relating to mines and economic geology; to chemistry, mineralogy and petrography; the publication of serial reports and special treatises, with illustrations; artists' work; labors of the staff in paleontology, zoology, economic botany, fruit growing. The extension of agriculture in the north, forestry, forest fires, preservation of timber; necessity for topographical surveying in unexplored regions; the compilation and engraving of maps, those published and those in course of preparation during the year; making of illustrative models of sections and surface relief; work in connection with the museum and library; aid given to education, distribution of reports, maps, suites of named specimens of minerals and

rocks; the collecting of fossils, rocks and minerals; the preparation of pamphlets and descriptive catalogues showing the mineral wealth of Canada; displays of economic minerals, etc., at international exhibitions; contributions to archeology and ethnology; extensive correspondence of the department, great variety of subjects treated of; information and encouragement given to prospectors and explorers; usefulness of the department as a means of introducing producers and consumers to each other, and in giving information and advice leading to the establishment of new industries.

Direction of Flow of the Ancient Beaver River Shown by Pot-holes: RICHARD R. HICE, Beaver, Pa. (Introduced by H. L. Fairchild.)

Evidence of the slope of abandoned fluvial plains is not always conclusive as regards the direction of flow of eroding stream. Evidence of pot-hole formation is conclusive. The abandoned fluvial plain of Beaver River near Rock Point and present stream's bed below Fallston dam in same sandstone were cited. Views were exhibited showing the difference between the up-stream side and down-stream side of pot-holes at Fallston dam, the down-stream side being eroded and rounded off, the up-stream side steep, perhaps undercut. View of pot-hole on abandoned fluvial plain near Rock Point, the steep side to the south, the rounded and eroded side to the north, thus showing that the forming stream flowed northward. Pot-holes are only found where stream is rapid, hence the ones on abandoned fluvial plain indicate that the eroding stream had considerable fall to the northward, and thus the unusual width of the 'inner' valley or gorge, north of Wampum, is partly due to the erosion of the old north-flowing stream.

The Origin of Ocean Basins on the Planetessimal Hypothesis: T. C. CHAMBERLIN, Chicago, Ill.

The Planetessimal Hypothesis of the origin of the solar system differs fundamentally from the Laplacian and other gaseous hypotheses, and from the meteoroidal hypothesis as set forth by Lockyer and Darwin. These latter assign the extension of the parent nebula to the opposed movements, collisions and rebounds of the constituent molecules or meteoroids. The former assigns it to concurrent orbital movement. In the gaseous and meteoroidal hypotheses (as usually understood) the aggregation is the simple work of gravity following a reduction of the oscillatory and colliding action. In the planetessimal hypothesis the aggregation is dependent on orbital conjunction. In the former the aggregation is massive and relatively rapid; in the latter the aggregation is individual and relatively slow. In the gaseous hypothesis the temperatures are necessarily very high, and the planets are formed by detachments. In the meteoroidal conception of George Darwin, the conditions are practically the same, and in that of Lockyer they differ rather in degree and in detail than in essence. In the planetessimal conception the planets grew up separately by innumerable accretions of infinitesimal planetoids (planetessimals) and the external temperatures were not necessarily high, since the orbits of the planetessimals were normally direct and concurrent and the aggregation came about by overtakes in contradistinction to opposed collisions, and the frequency of these was limited by the concurrent direction of orbital movement.

The purpose of the paper is to outline the hypothetical origin of the ocean basins under the planetessimal theory, to set forth the simple self-selecting process by which they were perpetuated and deepened, and

the connection of this with the dynamics of deformation.

In discussion A. C. Lane inquired as to the cause and amount of internal heat by the planetessimal hypothesis. The speaker replied that Osmund Fisher, at his request, had calculated that there would be abundant heat developed. H. F. Reid inquired regarding the visible stratification of planetessimals in the oldest known rocks, and regarding the distribution of land and water upon whose relations the study of other planets might throw light. Professor Chamberlin replied that the configuration of Mars and the moon threw no light on that of the earth; that the oldest rocks in the Lake Superior region conformed fairly well to the hypothesis. G. P. Merrill cited the basic character of meteoric material and the difficulty, therefore, of deriving acid rocks from it. The speaker replied that the hypothesis was not meteoroidal, but nebular. That he considered meteoroidal material a negligible quantity. The acidic character of the outer crust he attributed to siliceous volcanic contributions. G. K. Gilbert cited the results of his study of the moon as showing the effects of the impact of masses falling upon it, and supporting in this way the hypothesis. G. F. Becker reviewed the history of the nebular hypothesis, and showed that, even under the new hypothesis, we must assume an original nebula. He felt, therefore, that the essentials of the old conception could not be rejected. Bailey Willis made the point regarding the volcanoes of the moon, that they are explosive and yet on a planet without an atmosphere, whereas on the earth the explosions are due to steam. Professor Chamberlin replied that even on the earth volcanic action does not depend on surface water. Its vapors come from the depths.

Block Mountains of the Basin Range Province: W. M. DAVIS, Cambridge, Mass.

Observations of several of the Basin Ranges in the summer of 1902 support the opinion of Gilbert, Russell and others that the ranges observed are carved in uplifted or tilted blocks of earth-crust that had been previously much deformed and eroded. The faulting of the crustal blocks has been continued into recent geological time. The amount of erosion during the progress of faulting has been so great that the pre-fault topography cannot be safely determined.

The speaker pointed out the fact that the river valleys incised in these blocks are deep and narrow, the narrow gorges opening out suddenly on the open plains adjacent. Evidence, additional to that cited by Gilbert, of the linear character of the bases of the ranges, and of the triangular facets terminating the ridges in front, was given,—all corroborating the opinion that the ranges under consideration were formed by block faulting.

Origin of Basin Ranges: G. K. GILBERT, Washington, D. C.

Fresh interest in the origin of the Basin Ranges having been aroused by Mr. Spurr's communication to the Albany meeting of the society, the writer spent the summer of 1901 in the study of certain ranges of western Utah. The paper discussed the origin of these as indicated by their physiography and structure, and considered the nature of the evidence bearing on such questions. Evidence of block faulting was shown to exist in the nature of extensive shear zones, triangular facets terminating the ridges in front, and in the even linear bases of the ranges. That these faults are still going on was shown by displacements in the recent alluvium. On the basis of such evidence the writer was convinced that his former position regarding the origin of these ranges was correct.

Basin-Range Structure in the Death Valley Region of Southeastern California: M. R. Campbell, Washington, D. C.

Recently attention has been called to the geologic structure of the mountain ranges of Nevada and southeastern California. An attempt has been made to show that they are generally anticlinal in structure, and that the tilted-block type which Gilbert has described, and which is generally known as basin-range structure, is of rare occurrence.

The object of the present paper is to show that, although minor folding was observed in the Death Valley region, the mountains are generally composed of huge blocks of strata that have been strongly tilted and then eroded into their present forms.

The region described is traversed by two systems of structures; one extending in a north-south direction, being the southern extension of the true basin ranges of Nevada, and the other crossing these in a northwest-southeast direction parallel with and presumably an off-shoot from the main line of the Sierra Nevada. The movements which produced these structures seem to have been preceded by an epoch of slight folding in which the Paleozoic strata were somewhat deformed. This was followed presumably in Eocene time by faulting and tilting along northwest-southeast axes which formed parallel mountains and valleys trending in the same direction as the Sierra Nevada. In the valleys so formed lakes accumulated, probably through a change in climatic conditions, and sediments having a thickness of several thousand feet were laid down. In these lake beds are the great deposits of salt, gypsum, soda and borax, which have made the region famous. Following this period of sedimentation came one of movement along north-south axes, which lifted and tilted the surface into immense mountain ranges trending parallel with the new axes. Panamint, Death and Amargosa valleys were thus formed, and Funeral and Panamint mountains were raised up between them. Lakes formed in the new valleys and received sediments similar to those of the preceding period.

The age of the second lake-forming period is vaguely referred to late Tertiary. From structural and stratigraphic evidence the beds are younger than the lake sediments of Death Valley, and they are certainly older than the gravel deposits which mark the Pleistocene period in this region; therefore, they are provisionally classed as Miocene and younger.

The three papers on the Basin Range structure were discussed together.

C. R. Van Hise raised the question as to whether or not the entire displacement represented in these uplifted or tilted blocks was brought about by a single great fault or by a series of parallel breaks, which series he had termed a distributive fault. He was of the opinion that such a distributive fault was the usual if not necessary process in the production of mountains of this type.

W. M. Davis believed that a single great break would account for the phenomena observed by him, although the possible existence of parallel faults was admitted. G. K. Gilbert pointed out that, in some of the cases cited by him, parallel faults were evident, though not apparent in all instances.

The consensus of opinion as brought out by the discussion was that the evidence in the field did not support the views advanced by Mr. Spurr.

The presidential address was delivered Tuesday evening as follows:

Was Man in America in the Glacial Period? N. H. Winchell, Minneapolis, Minn.

A very enjoyable smoker was then tend-

ered the society by the fellows of the Geological Society of Washington.

The annual banquet took place at the Hotel Raleigh on Wednesday evening. One hundred and thirty-seven covers were laid.

The following papers were either read by title or were presented while the undersigned were absent on the fourth day of the session.

On the whole the meeting of the society was most successful. The attendance was probably the largest in its history, and the warmest thanks are due the Washington members for their efforts in entertaining so large a gathering.

Structural Relations in the Piedmont Area of Northern Maryland: EDWARD B. MATHEWS, Baltimore, Md.

Recent Shoreline Changes, Nantucket: F. P. GULLIVER, Southboro, Mass.

Timber Lines: ISRAEL C. RUSSELL, Ann Arbor, Mich.

Recent Volcanic Craters in Idaho and Oregon: ISRAEL C. RUSSELL, Ann Arbor, Mich.

Lakes Malheur and Harney, Oregon: ISRAEL C. RUSSELL, Ann Arbor, Mich.

Artesian Wells Near Enterprise, Idaho: ISRAEL C. RUSSELL, Ann Arbor, Mich.

Concretions and their Geological Effects: J. E. TODD, Vermilion, S. D.

Ordovician Rocks of the Bellefontaine, Penn., Section: GEORGE L. COLLIE, New Haven, Conn.

The Cambrian and Pre-Cambrian of Hoosac Mts., Mass.: JOHN E. WOLFF, Cambridge, Mass.

The Relation Between the Keewatin and Laurentide Ice Sheets: A. H. ELFTMAN, Minneapolis, Minn.

Post Glacial Time: A. H. ELFTMAN, Minneapolis, Minn.

Glacial Boulders Along the Osage River in Missouri: C. R. BUCKLEY, S. H. BALL, A. T. SMITH, Rolla, Mo.

Glacial Drainage in Central-Western New York: H. L. FAIRCHILD, Rochester, N. Y.

J. F. KEMP,
A. W. GRABAU.

COLUMBIA UNIVERSITY.

ESTEVAN ANTONIO FUERTES.

ESTEVAN ANTONIO FUERTES died at Ithaca, N. Y., January 16, after a long illness which had, nevertheless, only recently put a period to his professional work and to his service as director of the College of Civil Engineering of Cornell University. He was still Professor of Astronomy, in charge of the A. C. Barnes Astronomical Observatory of the university, which institute he had happily lived long enough to see completely erected and equipped.

Dr. Fuertes was born in San Juan, Porto Rico, May 10, 1838, the son of Estevan Fuertes, for many years governor of the island, and his wife, Demetria Charbonnier. The family is ancient and distinguished. Its members have often been remarkable for talent and have held prominent positions under the Spanish crown for generations. He was educated in his native province (Ph.D.) and at the Rensselaer Polytechnic Institute at Troy, N. Y., graduating as civil engineer (C.E.).

Returning to his native city after leaving Troy, he became, first, Assistant Engineer of Public Works, then Director of Public Works, Western Division of Porto Rico (1861–3). In 1863 he was made assistant engineer, and later engineer, of the Croton Aqueduct Board of New York city (1863–9); from which position he retired when unable to withstand the embarrassments to which he was subjected by the corrupt elements of the then city government.